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clear all;

% Parameters
Tend = 1.0;
b = 10.0;
c = b^2/4;
h3 = 0.005;

A3 = 1 + b/2 * h3 + c/4 * h3^2;
B3 = 1 + b/2 * h3 - c/4 * h3^2;
C3 = h3;
E3 = (1 - b/2 * h3)/(1 + b/2 * h3);
F3 = (-c/2 * h3)/(1 + b/2 * h3);

% Initialization
i = 1;
t(i) = 0.0;
y1(i) = 1;
y2(i) = 0;
Eh3 = zeros(1000,1);

% Exact solution
tt = linspace(0, Tend, 1000);
ye = (1 + b/2*tt).*exp(-b/2*tt);

% Recursive scheme for Theta method (h3)
while (t(i) + h3 < Tend + 1.e-12)
    y1(i+1) = B3/A3 * y1(i) + C3/A3 * y2(i);
    y2(i+1) = E3 * y2(i) + F3 * y1(i) + F3 * y1(i+1);
    Eh3(i+1,1) = abs(y1(i+1) - ye(i+1));
    t(i+1) = t(i) + h3;
    i = i+1;
end

% Compare numerical solution with exact solution
figure(1);
plot(tt, ye, '-', t, y1, 'r-o');
legend('Exact solution', 'Theta method (\Theta = 0.5) solution (h = 0.005)', 'Location', 'best');
xlabel('t');
ylabel('y(t)');

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